

Audit

Report



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ACQUISITION OF THE JOINT HELMET MOUNTED
CUEING SYSTEM

Report No. D-2001-103

April 18, 2001

This special version of the report has been revised to omit Contractor Proprietary data.

Office of the Inspector General
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Acronyms

JHMCS	Joint Helmet Mounted Cueing System
ORD	Operational Requirements Document
TEMP	Test and Evaluation Master Plan



INSPECTOR GENERAL
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April 18, 2001

MEMORANDUM FOR ASSISTANT SECRETARY OF THE AIR FORCE
(FINANCIAL MANAGEMENT AND COMPTROLLER)

SUBJECT: Audit Report on the Acquisition of the Joint Helmet Mounted Cueing
System (Report No. D2001-103)

We are providing this report for review and comment. This special version of the report has been revised to omit contractor proprietary information. We considered management comments on a draft of this report when preparing the final report.

DoD Directive 7650.3 requires that all recommendations and potential monetary benefits be resolved promptly. The Air Force comments were partially responsive. As a result of management comments, we made changes to findings A and B. However, the Air Force Program Executive Officer did not concur with Recommendation B.3. Therefore, we request additional comments from the Air Force Program Executive Officer on Recommendation B.3. by June 18, 2001.

We appreciate the courtesies extended to the audit staff. For additional information on this report, please contact Mr. Raymond A. Spencer at (703) 604-9071 (DSN 664-9071) (rspencer@dodig.osd.mil) or Mr. Thomas S. Bartoszek at (703) 604-9014 (DSN 664-9014) (tbartoszek@dodig.osd.mil). See Appendix C for the report distribution. The audit team members are listed inside the back cover.

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Office of the Inspector General, DoD

Report No. D2001-103

(Project No. D2000AB-0220)

April 18, 2001

Acquisition of the Joint Helmet Mounted Cueing System

Executive Summary

Introduction. The Joint Helmet Mounted Cueing System consists of a helmet and aircraft interface components that will allow aircraft fighter pilots to engage and destroy airborne targets within visual range with a first look, first shot, first kill advantage provided by the High-Off-Boresight Capability. The capability allows the pilots to engage, lock, and launch weapons at a target beyond the range of the aircraft's radar and within the pilot's field of view. The capability will not be available until after the Navy deploys the AIM-9X missile. The AIM-9X is currently in development with an estimated completion date of May 2003. If the missile is not deployed at the same time as the helmet, there will still be added capability because the helmet visor displays data needed during combat such as airspeed, altitude, target range, weapons, sensors, and navigation. The Air Force plans to employ the Joint Helmet Mounted Cueing System as upgrades on the F-15 C/D and F-16 C/D blocks 40 and 50 aircraft, and insert the helmet into the production line for the F-22. The Navy plans to incorporate the helmet in the F-18 E/F production line and as a planned upgrade to the F-18 C/D model. The Joint Helmet Mounted Cueing System is a joint Air Force and Navy Acquisition Category III program under the milestone decision authority of the Air Force Program Executive Officer for Fighter and Bomber Programs. The helmet is in the engineering, manufacturing, and development phase of the acquisition cycle and is scheduled for a Milestone III full-rate production decision in April 2002. As of December 31, 1999, the estimated total program cost was about \$672 million.

Objectives. The audit objective was to evaluate the overall management of the Joint Helmet Mounted Cueing System. Specifically, the audit determined whether the Air Force is cost-effectively readying the system for the production phase of the acquisition process. We also evaluated the management control program as it related to the overall objectives. This report addresses testing and evaluation and contracting. A later report will address requirement evolution and affordability and joint management.

Results. The Joint Helmet Mounted Cueing System operational tests, as planned, would not provide the objective test results necessary to support the full-rate production decision in April 2002. As a result, the Air Force would spend about \$6 million for operational testing without adequately determining whether the system will be operationally effective, suitable, and would provide the warfighter with a first look, first shot advantage within visual range in the air-to-air combat arena (finding A). In addition, the acquisition approach of the joint program needed improvement to recognize the risks associated with the rebaseline and the contracting structure of the Joint Helmet Mounted Cueing System program, and to explore component breakout opportunities for full-rate production. As a result, the evaluation, identification, and management of contractor performance is at risk, and the joint program office would miss the opportunity to put approximately \$17 million of funds to better use through

purchasing five components directly from manufacturers and eliminating the non-value-added overhead profit of 25 percent from intermediate tiers of contractors (finding B). See Appendix A for details on the management control program on updating controls in the operational testing and the acquisition plan.

Summary of Recommendations. We recommend that the Air Force Program Executive Officer for Fighter and Bomber Programs require the Joint Helmet Mounted Cueing System Program Manager to update the Test and Evaluation Master Plan; identify threat threshold and enhancement objective values of the system; conduct and present a component breakout study as exit criteria for the engineering, manufacturing, and development phase; revise the acquisition plan; and establish a process to regularly update the Test and Evaluation Master Plan and the Single Acquisition Management Plan. We also recommend that the Commander, Air Force Operational Test and Evaluation Center, revise the Multi-Service Operational Test and Evaluation Plan, identify pass-and-fail criteria for the questionnaires, and revise the projection plan.

Management Comments. The Air Force Program Executive Officer for Fighter and Bomber Programs agreed to update the Test and Evaluation Master Plan, to conduct a component breakout study, and to revise the acquisition plan. He did not concur with establishing a process to update the acquisition plan because he stated that a process already exists. In addition, he believed that only \$5 million of funds may be put to better use from component breakout because the audit eliminated all contractor profit. The Commander, Air Force Operational Test and Evaluation Center, disagreed with revising the Multi-Service Operational Test and Evaluation Plan to identify pass-and-fail criteria for the questionnaires used to evaluate human factors and revising the statistical projection plan. Because of affordability considerations, he stated that the questionnaires were intended to gather subjective inputs and that the Center staff would combine the responses with other data to judge the operational effectiveness and suitability of the helmet. He stated that the Joint Helmet Mounted Cueing System human factor issues will be rated as favorable if the majority of the ratings are positive and unfavorable if the majority of the ratings are negative. He stated that additional interviews will be conducted in instances where the ratings do not provide a clear answer. The complete text of management comments is in the Management Comments section.

Audit Response. We consider the management comments to be partially responsive. If the program office had a process to update the acquisition plan, it would have updated it after the rebaseline. Our calculation of potential monetary benefits was a target amount that excluded the prime and subcontractor's profits because the components would be purchased directly from the manufacturers. We understand that the exact amount of benefits will not be known until the contract is negotiated. The Director, Air Force Operational Test and Evaluation Center, provided an acceptable alternative plan of action to assess the system's operational suitability in relation to human factors.

We request that the Air Force Program Executive Officer for Fighter and Bomber Programs provide additional comments by June 18, 2001, on the establishment of a process to update planning documents.

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Background

The Joint Helmet Mounted Cueing System (JHMCS) consists of a helmet and aircraft interface components that will allow aircraft fighter pilots to engage and destroy airborne targets within visual range with a first look, first shot, first kill advantage provided by the High-Off-Boresight Capability and other sensors and weapons. The capability allows the pilots to engage, lock, and launch weapons at a target beyond the range of the aircraft's radar and within the pilot's field of view. The capability will not be available until after the Navy deploys the AIM-9X missile currently in development. The JHMCS also displays data needed during combat such as airspeed, altitude, target range, weapons, sensors, and navigation in the visor. The feature saves time when engaged in combat because the pilot can view vital information in the visor instead of on the cockpit display panel. The Air Force plans to employ the JHMCS as upgrades on the F-15 C/D and F-16 C/D blocks 40 and 50 aircraft, and insert the JHMCS into the production line for the F-22. The Navy plans to incorporate the JHMCS in the F-18 E/F production line and as a planned upgrade to the F-18 C/D model. The two aircraft that will first receive the JHMCS are the Navy F-18 E/F and the Air Force F-15 C/D models. The Boeing Company is the prime contractor for the F-18 and the F-15 aircraft and the JHMCS. Boeing will integrate the helmet into the aircraft. Lockheed Martin is the manufacturer for the F-16 and F-22 aircraft and will integrate the helmet into these aircraft.

The JHMCS is a joint Air Force and Navy Acquisition Category III program under the milestone decision authority of the Air Force Program Executive Officer for Fighter and Bomber Programs. The JHMCS is in the engineering, manufacturing, and developing phase of the acquisition cycle, which began in January 1997 with planned completion in March 2002. The development contract was a cost-plus-award-fee instrument for approximately \$77 million. The Program Executive Officer had scheduled the Milestone III, full-rate production decision for September 2001, with operational testing to begin in December 1999 for the F-18 and in October 2000 for the F-15. However, in December 1999, several technical challenges remained during development including system maturity, reliability, and maintenance. The Program Executive Office restructured the program and rescheduled the production decision for April 2002 with operational testing to begin in September 2001. The restructure extended the engineering, manufacturing, and development phase until March 2002 permitting time to solve the problems. Also, the JHMCS joint program office added a second low-rate initial production to commence in March 2001 for the F-15, F-16, F-18 E/F and F-22 aircraft. The first low-rate initial production for the F-18 began in May 2000. Restructure costs totaled about \$22 million. As of December 31, 1999, the joint program office for the JHMCS estimated that the cost for developing and producing 1,776 helmets to be \$641 million, which included changes to 1,882 aircraft.

Objectives

The audit objective was to evaluate the overall management of the JHMCS. Specifically, the audit determined whether the Air Force is cost-effectively readying the system for the production phase of the acquisition process. The audit was conducted in accordance with the Inspector General, DoD, critical program management element approach. See Appendix A for a discussion of the audit scope and methodology, the management control program, and prior audit coverage. This report addresses testing and contracting. A later report will address requirement evolution and affordability and joint management.

A. Utility of Planned Operation Testing

The JHMCS operational tests, as planned, would not provide objective test results necessary to support the JHMCS full-rate production decision in April 2002 because of the following:

- The Operational Requirements Document (ORD) did not identify operational parameters and articulate requirements in measurable terms.
- The Test and Evaluation Master Plan (TEMP) was outdated and insufficient to provide the overall structure for an objective testing program and to ensure that the operational tests would provide objective results that can determine whether the program is operationally effective and suitable for meeting the warfighters' needs in entering production.
- The Multi-Service Operational Test and Evaluation Plan did not include a baseline threshold or objectives to measure success, did not include plans for a valid statistical projection, did not specify pass-and-fail criteria, and did not include a confidence level for questionnaires developed to measure and project human factor elements of critical operational issues.

As a result, the Air Force would spend about \$6 million for operational testing without adequately determining whether the JHMCS will be operationally effective, suitable, and provide the warfighter with a first look, first shot advantage within visual range in the air-to-air combat arena.

Testing Criteria

The DoD Regulation 5000.2-R "Mandatory Procedures for Major Defense Acquisition Programs and Major Automated Information System Acquisition Programs," dated October 23, 2000, provides that the ORD define the system capability needed to satisfy the mission need and identify operational performance parameters in measurable terms. The parameters must identify a minimum acceptable value (threshold) required to satisfy the mission need and may contain objective values that represent a measurable beneficial increase in capability above the threshold.

The Regulation also states that the TEMP, which outlines the overall structure and the objectives of the testing program, provides the operational testing program to evaluate whether the system is operationally effective and suitable to satisfy the mission need before the full-rate production decision. The TEMP must also provide a framework to generate detailed test and evaluation plans. In this respect, the TEMP must identify critical operational effectiveness and suitability issues, measures of effectiveness, and measures of performance with

appropriate quantitative criteria to provide evidence for analysis of the system. Program officials must update the TEMP at milestones or when other events change the program significantly.

Operational Requirements Document

The ORD, dated December 18, 1996, states that the mission need was to attain a first look, first shot advantage in air-to-air combat within visual range over the threat identified. The ORD identified the threat as the Russian's advanced AA-11 air-to-air missile with a helmet-mounted sight employed on the MIG 29 and SU27 fighters. To achieve the advantage, the ORD provided that the new system should enhance the capabilities of aircrews. The ORD did not identify the system functions in defined terms and did not address system performance characteristics in terms of minimal acceptable threat thresholds, enhancements, or objectives that would provide the advantage.

Officials from the Air Combat Command who prepared the ORD stated that to apply additional technical performance criteria would only increase the risk of driving the scenarios to meet specific test points, instead of assessing how the helmet enhanced the weapon employment opportunities in tactical scenarios.

The absence of measurable threat thresholds and enhancement objective values may only result in enhancements to the present system and may not achieve any actual improvement in performance over the threat. The ORD does not define the threshold values of the threat and objective values as enhancements beyond a threat baseline. Defining those values will help ensure that pilots equipped with the JHMCS will have a distinct measurable advantage over the threat in air-to-air combat.

Test and Evaluation Master Plan

The approved TEMP, dated November 27, 1996, includes aspects of the program that are outdated and incomplete. For example, one platform system designated to obtain the JHMCS capability was the Navy's AV-8B. Officials from the joint program office indicated that the platform was a goal platform and not one designated to receive the JHMCS. In addition, the Navy did not fund the helmet for the AV-8B. Further, the schedule in the TEMP showed production to occur in 2000 and operational testing to commence in late 1999. The TEMP identified measures of effectiveness but did not include measures of performance or contain appropriate quantitative criteria, such as threshold and objective values to provide evidence for analysis of the system, in part, because the ORD did not provide minimum threshold and objective values as a baseline for measurement. Program officials stated that they attempted to update the TEMP in March 1998; however, because the potential for restructure was apparent, they decided to wait until after the restructure when funding decisions and other concerns that might impact testing would be made. The restructure in December 1999 rescheduled the production decision until April 2002 and the

operational testing until September 2001. Also, the restructure added a second low-rate initial production to the program. These changes were not included in the TEMP.

The joint program office must update the TEMP to reflect the current posture of the program after the restructure. The TEMP must identify appropriate quantitative criteria, such as threshold and objective values, to provide evidence for analysis of the system, thereby ensuring that the requirements of the user to achieve a first look, first shot capability are met. The TEMP must also be an effective outline for the overall testing structure of the program and provide the foundation for objective operational tests.

Multi-Service Operational Test and Evaluation Plan

The Multi-Service Operational Test and Evaluation Plan (the Plan), dated October 1999, is designed to determine the operational effectiveness and suitability of the JHMCS and whether the system is ready for production. To assist the testers in answering the effectiveness and suitability questions, the Plan identified the following four critical operational issues structured in the form of a question, which the testers must address:

- Does the JHMCS enhance air-to-air weapon employment opportunities in a Within Visual Range environment?
- Does the JHMCS effectively interface and operate with the aircrew and required systems?
- Does the JHMCS reliability and maintainability support the operational tasking?
- Is the JHMCS supportable in the operational environment?

The Plan did not fully detail the first two operational issues. The first issue involves the ability of the JHMCS to enhance the capability of the warfighter. To satisfy the requirement, the Plan proposed a series of missions that compared the first look, first shot performance of like friendly aircraft with and without the JHMCS. While the missions will provide some insight into the JHMCS enhanced capabilities, they will not establish a minimum acceptable threshold against the threat. The absence of a minimum threat and objective values in the ORD and the TEMP contributed to the testers' decision to use friendly aircraft data to measure and report the operational effectiveness and suitability of the program.

The ORD defines the system capability needed to satisfy the mission need and identifies operational performance parameters in measurable terms. The parameters must identify a minimum acceptable value (threshold) required to satisfy the mission need and may contain objective values that represent a measurable beneficial increase in capability above the threshold.

After the warfighter defines the threshold and objective values in the ORD and TEMP, the test agency must update the Plan to reflect the criteria for measuring operational effectiveness and suitability of the JHMCS to enhance air-to-air weapon employment opportunities.

The second issue addresses human factors such as display, comfort, situational awareness, and day and night operability. To help assess the factors, the 12 pilots who are designated to fly the operational testing missions will complete a questionnaire regarding their experience using the system. The following two questions and answers are a sample of those included in the questionnaire.

1. Rate the acceptability of the JHMCS comfort on a “normal” duration mission (1.5 hours).

Completely Unacceptable	Largely Unacceptable	Somewhat Unacceptable	Somewhat Acceptable	Largely Acceptable	Completely Acceptable	Not Applicable
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2. Rate the acceptability of the fit of the JHMCS.

Completely Unacceptable	Largely Unacceptable	Somewhat Unacceptable	Somewhat Acceptable	Largely Acceptable	Completely Acceptable	Not Applicable
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However, the testers had not defined pass-and-fail criteria for the answers to the questions. Testing officials stated that they plan to analyze the operator rating of human factors after the questionnaires are completed. The results will appear in the final test report, allowing the warfighters to decide whether to acquire the system. In addition, because each test pilot interaction is independent, the testers intend to use statistical sampling methods to accurately project the operational effectiveness of human factors to the universe of Air Force and Navy pilots that are targeted to be outfitted with the helmet. The testers did not have a statistical plan or process in place to evaluate the results. Accordingly, the small size of their pilot sample and its nonrandom nature precludes valid conclusions. Finally, the Plan does not identify an acceptable level of confidence for the questionnaire.

Considering the complex nature of the questionnaire, the lack of pass-and-fail criteria, and the lack of a defined confidence level, the current method of evaluation does not provide a decision structure that permits clear answers on the system’s operational effectiveness and suitability for evaluating human factors. Accordingly, the testers must revise the Plan to recognize these key aspects.

Conclusion

The DoD Regulation 5000.2-R provides that the ORD define the system capability needed to satisfy the mission need and identify operational performance parameters in measurable terms. Threat thresholds and objective values must be defined in the ORD, the TEMP, and the Plan. In addition, the TEMP must provide a framework within which to generate detailed test and

evaluation plans that include critical operational effectiveness and suitability issues, measures of effectiveness, and measures of performance with appropriate quantitative criteria. The joint program office must update the TEMP when significant events occur that change the program.

The Air Force will not have objective test results at the full-rate production decision because the ORD, the TEMP and the Plan did not define the threat threshold and objective values. Also, the Plan did not include pass-and-fail criteria, a valid statistical projection process, and confidence level for evaluation of human factors through questionnaire. As a result, the Air Force will spend about \$6 million for operational testing without determining whether the JHMCS will be operationally effective, suitable, and provide the warfighter with a first look, first shot advantage within visual range in air-to-air combat.

Program Executive Office for Fighter and Bomber Programs

On October 18, 2000, we met with senior officials from the Air Force Program Executive Office for Fighter and Bomber Programs to discuss the testing issues. We discussed the ORD, TEMP, and Plan issues. Senior officials stated that the program would be completed before the ORD was updated, revised, and approved; therefore, they suggested that we recommend changes to the TEMP and, accordingly, the revisions would be incorporated in the Plan when the TEMP was revised. In addition, because the warfighters and test agencies are concurrence officials in the TEMP approval process, all interested parties would validate the revisions and decisions before operational testing would begin.

While they do not conform to the strict interpretation of DoD Regulation 5000.2R, the recommended actions will accomplish the objectives because they involve the testers, the warfighters, and the joint program office.

Management Comments on the Finding and Audit Response

Program Executive Officer for Fighter and Bomber Programs Comments. The Program Executive Officer for Fighter and Bomber Programs did not agree that the ORD failed to identify operational parameters and articulate requirements in measurable terms. He stated that while the ORD requires the JHMCS to cue the radar, navigation system, missiles and display information in the visor, the objective technical requirements or parameters are included in the technical and engineering documents. Accordingly, if the JHMCS meets these parameters, pilots will achieve a first shot advantage. He further stated that the threat examples identified in the ORD were used to establish objective evaluation criteria. A failure of the cueing and displaying capabilities noted during testing will be reflected in objective measurable readiness and logistics ratings for operational suitability and effectiveness. He also disagreed that the Multi-Service Operational Test and Evaluation Plan did not include a baseline threshold or objectives to measure success, did not include plans for a valid statistical projection, did not specify pass-and-fail criteria, and did not include a confidence level for questionnaires developed to measure and project human

factor elements of critical operational issues. He stated that the plan was consistent with the original TEMP and contained test procedures to satisfy critical operational issues and to meet measures of performance. In addition, the updated TEMP and the Plan will include test procedures to evaluate the JHMCS capability against the threat. The results will be included in the operational effectiveness assessment. He stated that responses to the human factor questionnaires will depend on the judgment of the testers and will provide insight into the system characteristics that can be used to develop training or make refinements in operational concepts. See Appendix A for additional comments on the cited management control deficiencies.

Audit Response. The Air Force Program Executive Officer for Fighter and Bomber Programs stated that the ORD defined the functions of JHMCS. He stated that the operational parameters and requirements for these functions, stated in measurable terms, are included in technical and engineering documents. However, DoD Regulation 5000.2-R clearly provides that the ORD and not subsequent engineering documents developed by the contractor define the system capability needed to satisfy the mission need and identify operational performance parameters in measurable terms. The parameters must identify a minimum acceptable value (threshold) required to satisfy the mission need and may contain objective values that represent a measurable beneficial increase in capability above the threshold. While engineering documents are valuable in defining the system's actual characteristics in meeting the requirements of the ORD, the ORD must set the standard for the JHMCS and not the engineering documents. The warfighter and not the contractor must clearly be in control of requirements determination and the definition for the system's capability in terms of thresholds and objective values.

He also stated that the Plan was consistent with the original TEMP and contained test procedures to satisfy critical operational issues and meet measures of performance. However, he did not address how the Plan established a minimum acceptable threshold and objective values against the threat to address the first two operational issues. Rather, the Plan does not include values or criteria to measure operational effectiveness and suitability of the JHMCS to enhance air-to-air weapons employment opportunities. The updated Plan should provide the needed baseline to measure success of critical operational issues.

Air Force Operational Test and Evaluation Center Comments. The Commander, Air Force Operational Test and Evaluation Center, did not agree that the Multi-Service Operational Test and Evaluation Plan excluded a baseline threshold and objectives to measure success, excluded plans for a valid statistical projection, excluded pass-and-fail criteria, and excluded a confidence level for questionnaires developed to measure and project human factor elements of critical operational issue. He stated that the baseline will be evaluated by comparing missions with and without the JHMCS on friendly aircraft. In addition, flights will be made against threat aircraft, if available, and the test team will conduct baseline comparisons of threshold aircraft with the JHMCS to the threat aircraft. The updated TEMP will include threat capabilities to be used for the baseline. Concerning the inclusion of pass and fail criteria and a confidence level for the subjective human factors, he stated that the results

would not be statistically valid for the small sample of test pilots. A valid statistical projection plan would require using a sample that would exceed resource availability for the benefits derived. The current sample is sufficient to provide clear answers concerning the impact of human factors elements on the operational effectiveness and suitability because test pilots consists of experts with extensive experience in determining military utility of the system under test. In addition, while it was not appropriate to apply objective pass and fail criteria to the human factors analysis of the JHMCS a definitive answer concerning the effectiveness and suitability of the human factors will be provided. For each subjective critical operational issue, measures of effectiveness, and measures of performance, the system will be rated as favorable if the majority of the rating is positive and unfavorable if they are rated unfavorable. Additional interviews will be conducted where the rating do not provide clear answers. In addition, descriptive statistics will be used to summarize the data and a narrative summary of the majority strengths and weaknesses of the system will be provided.

Audit Response. The JHMCS must enhance the capability of the warfighter beyond the threat to allow for a the first look, first shot performance. Although friendly missions will provide some insight into the JHMCS capabilities, they will not establish a minimum acceptable threshold against the threat. In addition, the missions will not provide an adequate assessment of the system's performance capabilities. By comparing flights made against actual threat aircraft or by a baseline comparison of threshold aircraft with the JHMCS to the threat aircraft, the enhanced capability of the system will be demonstrated and will determine if the helmet provides the first look, first shot performance. The actions to update the TEMP to include the threat capability to be used as a baseline are a positive step.

We agree that the sample size will not be statistically valid for projections based on a sample size of 12 pilots and that funds may not be available for additional pilots. The mathematical laws dictating the sample size required to address a question makes explicit the minimum amount of information needed. A smaller sampling necessarily collects less than this minimum and, logically, it is insufficient to provide clear answers. The two viable options are to either conduct an adequate sample or, if resources are insufficient, not conduct a sample at all. Performing an inadequate sampling at best will produce results recognized as insufficient, and at worst will yield insufficient results which nevertheless are used for management decision-making purposes. These will not provide clear answers on the impact of human factor elements on the JHMCS operational effectiveness and suitability. However, the Commander, Air Force Operational Test and Evaluation Center, agreed to institute a more objective process for analyzing the effectiveness of the JHMCS human factor issues. Setting an average favorable rating as a threshold for acceptance will provide the necessary insight into the degree of satisfaction acquired from its usage and the additional interviews in cases of ambiguous results and the use of descriptive analysis will provide further evidence of the systems operational suitability in relation to human factors.

Recommendations, Management Comments and Audit Response

A.1. We recommend that the Air Force Program Executive Officer for Fighter and Bomber Programs update the Test and Evaluation Master Plan to recognize changes as a result of the program restructure, identify the threat threshold and enhancement values of the system, and establish a process to update on a regular basis the Test and Evaluation Master Plan.

Air Force Program Executive Officer for Fighter and Bomber Programs Comments. The Air Force Program Executive Officer concurred and stated that the Test and Evaluation Master Plan was being updated and a draft was prepared in December 2000.

A.2. We recommend that the Commander, Air Force Operational Test and Evaluation Center, revise the Multi-Service Operational Test and Evaluation Plan to include changes made to the Test and Evaluation Master Plan that affect the Plan, identify pass-and-fail criteria for the questionnaires used to evaluate human factors, and revise the statistical projection plan.

Air Force Program Executive Officer for Fighter and Bomber Programs Comments. The Air Force Program Executive Officer nonconcurred with the recommendation. He said that the questionnaires are intended to gather subjective information to better understand the operational impact of the new system. The results of the questionnaires, along with other data, will allow testers to render an opinion on operational effectiveness and suitability.

Air Force Operational Test and Evaluation Center Comments. The Commander, Air Force Operational Test and Evaluation Center, nonconcurred with the recommendation. He stated that the Center would revise the Multi-Service Operational Test and Evaluation Plan to include changes made to the Test and Evaluation Master Plan as updates occur but would not agree to set pass-and-fail criteria for the human factors because the questionnaires were designed to collect subjective information in assisting the user to understand the effects of supporting and employing the system. As stated in his comments to the finding, he mentioned two problems that we identified in our report pertaining to the evaluation of human factors. The problems include the small nonrandom sample size and the lack of quantifiable pass-and-fail criteria for the subjective questionnaire. He stated that a valid statistical projection plan would require a sample that exceeded resource availability for the benefits derived. He stated that the sample the Center plans to use was sufficient to provide clear answers concerning the impact of human factor elements on the operational effectiveness and suitability because the test pilots employed were experts with extensive experience in determining the military utility of a system under test. In addition, for subjective critical operational issues, measures of effectiveness, and measures of performance, the Center will rate the system as favorable if the majority of the ratings are positive and unfavorable if the majority of the ratings

are unfavorable. The Center will also conduct additional interviews of the test pilots where the ratings do not provide clear answers. In addition, the Center will use descriptive statistics to summarize the data and provide a narrative summary of the strengths and weaknesses of the system.

Audit Response. The plan of action submitted by the Director, Air Force Operational Test and Evaluation Center, to assess the systems' operational suitability in relation to human factors met the intent of the recommendation.

B. Adequacy of Acquisition Planning

The JHMCS acquisition approach needed improvement because the acquisition plan is outdated, did not address low-rate initial production, did not recognize the risks associated with the restructure and the contracting structure of the JHMCS program, and did not explore component breakout opportunities for full-rate production. As a result, the evaluation, identification, and management of contractor performance is at risk. In addition, the joint program office would miss the opportunity to put funds of approximately \$17 million to better use.

DoD Acquisition Regulations

The DoD Regulation 5000.2-R, "Mandatory Procedures for Major Defense Acquisition Programs and Major Automated Information System Acquisition Programs," October 23, 2000, provides that each program manager develop an acquisition strategy to minimize the time and cost of satisfying a need. Essential elements include risk management, sources, and the contract and management approach. The joint program office must develop the strategy at the beginning of a program and update it when there is a change.

The Defense Federal Acquisition Regulation Supplement, Subpart 207.1--Acquisition Plans October 25, 2000, states that the acquisition plan should help officials plan for the evaluation, identification, and management of contractor performance risk. In addition, it should include a milestone chart depicting the acquisition objectives. The acquisition plan can embody the acquisition strategy.

The Defense Federal Acquisition Regulation Supplement also addresses component breakout, which is the process whereby the Government purchases components directly from the manufacturer and furnishes them to the end-item manufacturer as Government-furnished material. This process eliminates the prime contractor and other overheads and profits and achieves savings for the Government. It is DoD policy to break out components of weapons systems when it is anticipated through a breakout analysis that a prime contract will be awarded without adequate price competition; substantial net cost savings probably will be achieved; and the quality, reliability, performance, or timely delivery of the end item will not be jeopardized.

Single Acquisition Management Plan

The Single Acquisition Management Plan (the plan) records the acquisition strategy and plan for the JHMCS. The joint program office updated the plan in January 1997 to support the Milestone II Engineering, Manufacturing, and Development phase decision. The plan addressed only Milestone II. Because senior Air Force officials informed the joint program office that a revised plan would only be required before the production decision in April 2002, the joint

program office did not update the plan to recognize risks associated with low-rate initial production, the program restructure approved in December 1999, the contracting structure of the acquisition, and component breakout.

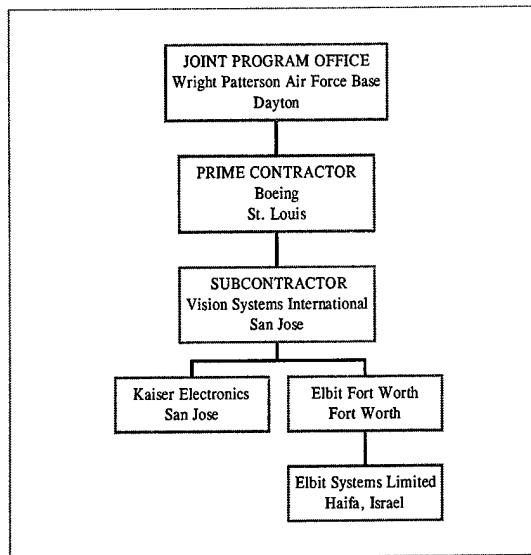
Low-Rate Initial Production. The acquisition strategy panel (the Panel) of March 12, 1999, addressed low-rate initial production for the F-18 E/F models. The Panel reviewed technical, management, and cost risks. It also rated the technical risks of design as low because the system was operating on the F-18 aircraft with only minor potential for redesign work. The Panel rated the technical risk of performance as moderate because of ejection safety qualifications and other qualification tests in progress. The Panel rated management risks as moderate because of the multi-Service involvement with many platforms, the AIM-9X missile schedule problems, and the subcontractor management. The Panel identified the cost risk as moderate because of the aggressive schedule, test uncertainties, AIM-9X integration, correction of deficiencies, and reliability of components. The Panel only considered cost when it evaluated and chose a firm-fixed-price contract. It recommended modifying the strategy to incorporate the low-rate initial production approach; however, the joint program office did not revise the plan or reconvene the Panel before low-rate initial production. Further, the joint program office did not update the plan to recognize the recommendations of the Panel and to analyze the technical risks involved.

Program Restructure. The program restructure of December 1999 changed the program's acquisition strategy by adding another low-rate initial production, changing the schedule for production until April 2002, and adding funds to address problems with the maturity of the High Off Boresight Capability and the reliability and maintenance of the helmet-vehicle interface for the F-18 aircraft.

The joint program office did not revise the plan to consider how the risks of program restructure affected the acquisition. In addition, the joint program office did not consider the risk of continuing development until the production decision of April 2002, while starting low-rate initial production on the F-18E/F aircraft in May 2000. An acquisition strategy and plan must include risk management, the management approach, and a milestone chart depicting the acquisition objective. The joint program office did not update the acquisition strategy and plan to recognize acquisition changes and risks resulting from the restructure.

Structure of the Acquisition. A hierarchical structure of contractor tiers exists between the joint program office and the manufacturers of the JHMCS. The Boeing Company is the prime contractor for the JHMCS and the integrator for the F-18 and F-15 aircraft. Boeing subcontracted the development effort to Vision Systems International, a limited liability corporation established by two firms, Kaiser Electronics and Elbit Fort Worth, who share equally in the development effort. Kaiser Electronics and Elbit Fort Worth established the structure at the initiation of the program when the two companies formed Vision Systems International to share in the development and risk. Elbit Fort Worth

subcontracted its share of development to its parent organization Elbit Systems Limited, in Haifa, Israel. The figure below shows the levels of contract management.



Contracting Hierarchy for the Joint Helmet Mounted Cueing System

Vision Systems International anticipated that the sales of the JHMCS would provide full production at all three facilities -- Kaiser, Elbit Forth Worth, and Elbit Israel. Vision Systems International officials indicated that development and low-rate initial production was occurring only at Kaiser Electronics and Elbit Systems in Israel. The other contractor levels provide some marketing and development support, but do not participate in the actual manufacturing process.

The structure of contracting for the JHMCS includes many levels of overhead and profit. The acquisition plan did not address the levels of contracting, risk management, sources, contract and management approaches, and benefits derived, if any, by the Government for maintaining the current contracting structure. The joint program office did not revise the plan after the restructure to consider these factors.

Breakout Candidates. The acquisition plan did not address component breakout for full-rate production. We identified five potential breakout components for the JHMCS: the electronics unit, the magnetic transmitter unit, the cockpit unit, the cathode ray tube, and the helmet-mounted display test set. We reviewed the date of the latest configuration change, whether the component was returned for rework, the reason for the rework, and any impact on the configuration. See the table below.

Component Breakout Candidates, Date of Latest Configuration Change and Returns for Rework

Component Description	Date of Latest Configuration Change	Returned to Vendor for Rework (Y/N)
Electronics Unit	05/04/99	Y
Cathode Ray Tube	04/29/98	N
Cockpit Unit	07/06/00	Y
Magnetic Transmitter Unit	12/16/98	Y
Test Set	09/17/98	N

Contractor officials at Vision Systems International and Boeing indicated that all the components we identified are stable. Two components were not returned for rework. Although three components were returned, officials stated that the rework resulted in no major design changes.

The DoD Regulation 5000.2R requires consideration of component breakout. The acquisition plan should address the risks associated with breakout such as quality, reliability, performance, and timely delivery. As the program approaches the end of the engineering, manufacturing, and development phase, the joint program office must conduct a component breakout review to identify potential candidates for breakout during full-rate production.

Benefits of Component Breakout

The Air Force and Navy could put \$16.9 million to better use if the joint program office purchased the five components from the manufacturers and delivered them to Boeing as Government-furnished equipment. (Appendix B. Estimated Component Breakout Savings). Our calculation excluded overhead and profit for two management levels, Boeing and Vision Systems International. We used the quantities funded from 2002 through 2005. The joint program office should perform component breakout reviews for all components as required before the production decision and include the results in the acquisition plan and as exit criteria for the current acquisition phase.

Conclusion

The DoD Regulation 5000.2R provides that each program manager develop an acquisition strategy and plan to include the evaluation, identification, and management of contractor performance risk, contract sources, management approach, and milestone chart of events. The joint program office must update the acquisition strategy when there are changes that affect the acquisition approach. Also, the Regulation requires a component breakout review to be

conducted to determine whether substantial net cost savings can be achieved through breakout without jeopardizing the quality, reliability, performance, or timely delivery of the end item. The JHMCS joint program manager did not update the acquisition plan to recognize recommendations of the acquisition strategy panel for the low-rate initial production, the impact of the program restructure, the contracting structure of the JHMCS acquisition, and the potential savings generated by component breakout once production begins. The acquisition plan needed to be updated to consider the changing facets of the program.

Management Comments on the Finding and Audit Response

Management Comments on Acquisition Planning. The Air Force Program Executive Officer nonconcurred with the finding that acquisition planning is outdated. He stated that although the Single Acquisition Management Plan has not been updated since approved in 1996, the planning and strategy have been updated in steering group and strategy panel meetings, which the milestone authority approved. Those activities occurred in the context of an acquisition plan update. He agreed that the Single Acquisition Management Plan will be updated to consolidate program changes and documentation since the last milestone review.

The Air Force Program Executive Officer also nonconcurred that the risk assessment process was inadequate. He stated that they followed the Aeronautical Systems Center policies and procedures and conducted risk analysis for low rate initial production 1 and 2. In addition, they have extensive risk assessment processes for all technical issues of the program. He stated that they manage technical, programmatic, and integration risk across the program in a prudent and cost-effective manner.

The Program Executive Officer further commented that component breakout is not considered possible until development is completed. He nonconcurred with our position that the JHMCS acquisition plan does not address potential cost savings of component breakout for full rate production. He also nonconcurred with the estimated savings of \$17 million and stated our analysis is flawed because we eliminated the Boeing profit and the VSI profit, which is in conflict with the DoD acquisition regulations. He suggested the savings would be about \$5 million. The Program Executive Officer also made additional comments on the report's background and appendix sections. Additional comments are included in the Appendix A.

Audit Response. We recognize that the program has steering group and strategy panel meetings to address low rate initial production and technical challenges, but the results were not included in the acquisition plan. By doing so, the plan would encapsulate the acquisition approach and strategy of the JHMCS in one document instead of several. Revising the acquisition plan would also embody the results of changes in strategy and ensure that the Air Force and other interested parties would have the current approach to acquisition in one document. In addition, the DoD Regulation 5000.2-R,

requires program managers to develop an acquisition strategy and plan to address risk management, sources, and the contract and management approach, and to update them when there is a change. This was not done.

Concerning risk assessments, our report did not state that the risk assessment process was inadequate. Rather, it stated that the acquisition approach was inadequate because the acquisition plan did not address low-rate initial production, did not recognize the risks associated with the restructure and the contracting structure of the JHMCS program, and did not explore component breakout opportunities for full-rate production. The report indicated that the acquisition panel for the low-rate initial production recommended modifying the strategy to incorporate the low-rate initial production approach; however, the joint program office did not revise the plan or reconvene the Panel before low-rate initial production. In addition, the joint program office did not update the plan to recognize the recommendations of the Panel and to analyze the technical risks involved.

Concerning the restructure, the acquisition plan did not consider the risks of continuing development until the production decision of April 2002, while low-rate initial production started on the F-18E/F aircraft in May 2000. An acquisition strategy and plan must include risk management, the management approach, and a milestone chart depicting the acquisition objective. The joint program office did not update the acquisition strategy and plan to recognize acquisition changes and risks resulting from the restructure.

The Program Executive Officer apparently did not understand that the Boeing and VSI profits would be excluded on a component breakout basis because Boeing and VSI would not be involved in the acquisition. Our \$17 million calculation excludes the Boeing and VSI profits because the components would be purchased directly from the manufacturers Kaiser and Elbit, Fort Worth. The components would then be shipped to Boeing or Lockheed and provided as Government-furnished supplies. The \$17 million is a target amount and we understand that actual contract negotiations will result in a different amount. As such, we will perform followup to determine the amount of monetary benefits the Air Force will actually achieve. Concerning the comments on the background and executive summary sections, we made appropriate changes.

Recommendations, Management Comments, and Audit Response

B. We recommend that the Air Force Program Executive Officer for Fighter and Bomber Programs require the Joint Helmet Mounted Cueing System program manager to:

1. Conduct and present a component breakout study as exit criteria for the engineering, manufacturing, and development phase that includes an analysis of potential net cost savings that can be achieved; and a review of the quality, reliability, performance, and the timely delivery of the end item that may be jeopardized.

Management Comments. The Air Force Program Executive Officer concurred, and stated that his office provided direction to the program office to conduct a breakout study in August 2000.

2. Revise the acquisition plan to include the results of the breakout study, the risks associated with low-rate initial production while in development, the restructure of the program, and the contracting structure of acquisition.

Management Comments. The Air Force Program Executive Officer concurred, and stated that the acquisition plan will be updated to support Milestone 3.

3. Establish a process to update the acquisition plan on a regular basis.

Management Comments. The Air Force Program Executive Officer nonconcurred, stating that no special process is required because the acquisition planning document will continue to be updated consistent with DoD and Air Force policy.

Audit Response. The Air Force comments are not responsive. We do not believe that the JHMCS program office has a process because if it did the acquisition plan would have been updated at the time of the rebaseline or other critical events as mandated by DoD Regulation. Therefore, we request that the Air Force provide additional comments in response to the final report.

Appendix A. Audit Process

Scope and Methodology

The overall audit objective was to evaluate the acquisition of the JHMCS. Specifically, the audit determined whether the Air Force is cost-effectively readying the system for the production phase of the acquisition process. The audit was performed in accordance with the Inspector General, DoD, critical program management element approach, and we reviewed program management elements pertaining to requirement evolution and affordability, test and evaluation, contracting, and joint management. We reviewed program data from December 1996 through November 2000. We also evaluated the management control program as it related to the overall objective.

We performed this economy and efficiency audit from June 2000 through November 2000 according to standards implemented by the Comptroller General for the United States, as implemented by the Inspector General, DoD. We used criteria in the DoD Regulation 5000.2R to perform the audit. To accomplish the audit objectives, we determined that the JHMCS joint program management office had developed and implemented an acquisition plan and a test and evaluation plan.

Use of Computer-Processed Data. We did not use computer-processed data to perform this audit. The Technical Assessment Division, Audit Followup and Technical Support Directorate, Office of the Inspector General, provided expertise in the area of testing including operational test planning.

Contacts During the Audit. We visited or contacted individuals and organizations within the Departments of the Air Force and the Navy. We also visited or contacted individuals and organizations within DoD and contractor and subcontractor officials.

DoD-Wide Corporate Level Government Performance and Results Act Coverage. In response to the Government Performance and Results Act, the Secretary of Defense annually establishes DoD-wide corporate level goals, subordinate performance goals, and performance measures. This report pertains to achievement of the following goal and subordinate performance goal.

FY 2001 DoD Corporate Level Goal 2: Prepare now for an uncertain future by pursuing a focused modernization effort that maintains U.S. qualitative superiority in key warfighting capabilities. Transform the force by exploiting the Revolution in Military Affairs, and reengineer the Department to achieve a 21st century infrastructure. (01-DoD-02).

FY 2001 Subordinate Performance Goal 2.4: Meet combat forces' needs smarter and faster, and products and services that work better and cost less, by improving the efficiency of DoD acquisition processes. (01-DoD-2.4)

General Accounting Office High-Risk Area. The General Accounting Office had identified several high-risk areas in the DoD. This report provides coverage of the Defense Weapon System Acquisition high-risk area.

Management Control Program Review

DoD Directive 5010.38, "Management Control (MC) Program," August 26, 1996, and DoD Instruction 5010.40, "Management Control (MC) Program Procedures," require DoD managers to implement a comprehensive system of management controls that provide reasonable assurance that programs are operating as intended and to evaluate the adequacy of the controls.

Scope of the Review of the Management Control Program. In accordance with DoD Directive 5000.1, "Defense Acquisition System," October 23, 2000, and Department of Defense Regulation 5000.2-R, "Mandatory Procedures for Major Defense Acquisition Programs and Major Automated Information System Acquisition Programs," dated October 23, 2000, acquisition managers are to use program cost, schedule, and performance parameters as control objectives to implement the requirements of DoD 5010.38. Accordingly, we limited our review to management controls directly related to the acquisition management of the JHMCS.

Adequacy of Management Controls. In evaluating the management control process, we identified material management control weaknesses for the JHMCS joint program office as defined by DoD Instruction 5010.40. The JHMCS joint program office management controls for updating the acquisition and testing plans were not adequate to ensure that the plans contained current information on the status and risks associated with the program. Recommendations A.1. and B. 2., if implemented, will improve the updating process and procedures, and could result in potential monetary benefits of about \$17 million (Appendix B). A copy of the report will be provided to the senior officials responsible for management controls in the Air Force.

Adequacy of Management's Self-Evaluation. In evaluating the management control process, we reviewed the risk-management program to determine the level of risk that the officials assigned to aspects of the helmet. We also reviewed the Annual Statements of Assurance for the Air Force for FYs 1998 and 1999 to determine whether any weaknesses had been reported relating to the JHMCS program. Air Force officials did not identify procurement and testing of the helmet as an assessable unit and therefore did not identify or report the material management control weaknesses identified by the audit.

Prior Coverage

During the last 5 years, there has been no prior coverage on the JHMCS.

Management Comments on Management Control Weaknesses

Management Comments. The Air Force Program Executive Officer stated that test plans are living documents and are constantly being updated. In addition, the acquisition strategy and risk assessments are clearly documented in other than the Single Acquisition Management Plan. Accordingly, the controls for managing the testing and acquisition planning are adequate.

Audit Response. While plans are in place to address testing and acquisition, they are not current and do not portray the status of the program after the rebaseline and other programmatic changes. Since there was no process in place to update the testing and acquisition documents, this represents a management control weakness.

Appendix B. Component Breakout

	Electronics Unit	Magnetic Transmitter Unit	Cockpit Unit	Cathode Ray Tube	Total Savings
EFW ¹ /KE ² price per unit	\$ * ¹	\$ *	\$ *	\$ *	\$ *
³ VSI overhead and profit	*	*	*	*	*
Boeing overhead and profit	*	*	*	*	*
Mark up per unit	\$ *	\$ *	\$ *	\$ *	\$ *
Quantity FY 2002-2005	*	*	*	*	*
Total	\$ *	\$ *	\$ *	\$ *	\$16,928.97.

¹EFW
²KE
³VSI
 Elbit Fort Worth
 Kaiser Electronics
 Vision Systems International

¹ Contractor proprietary data removed.

Appendix C. Report Distribution

Office of the Secretary of Defense

Under Secretary of Defense (Comptroller)
Deputy Chief Financial Officer
Deputy Comptroller (Program/Budget)
Under Secretary of Defense for Acquisition, Technology, and Logistics
Director, Operational Test and Evaluation

Department of the Navy

Naval Inspector General
Auditor General, Department of the Navy

Department of the Air Force

Assistant Secretary of the Air Force (Financial Management and Comptroller)
Auditor General, Department of the Air Force
Air Force Program Executive Officer, Fighter and Bomber Programs

Non-Defense Federal Organization

Office of Management and Budget

Congressional Committees and Subcommittees, Chairman and Ranking Minority Member

Senate Committee on Appropriations
Senate Subcommittee on Defense, Committee on Appropriations
Senate Committee on Armed Services
Senate Committee on Governmental Affairs
House Committee on Appropriations
House Subcommittee on Defense, Committee on Appropriations
House Committee on Armed Services
House Committee on Government Reform
House Subcommittee on Government Efficiency, Financial Management, and Intergovernmental Relations, Committee on Government Reform
House Subcommittee on National Security, Veterans Affairs, and International Relations, Committee on Government Reform
House Subcommittee on Technology and Procurement Policy, Committee on Government Reform

Department of the Air Force Comments



DEPARTMENT OF THE AIR FORCE
AIR FORCE PROGRAM EXECUTIVE OFFICE
WASHINGTON, DC 20330-1060

30 JAN 2001

MEMORANDUM FOR: ASSISTANT INSPECTOR GENERAL FOR AUDITING
OFFICE OF THE INSPECTOR GENERAL
DEPARTMENT OF DEFENSE

FROM: AFPEO/FB
1060 Air Force Pentagon
Washington DC 20330-1060

SUBJECT: Audit Report on the Acquisition of the Joint Helmet Mounted Cueing System
(Project No. D2000AB-0220), dated December 8, 2000

This is in reply to your memorandum requesting the Assistant Secretary of the Air Force (Financial Management and Comptroller) provide Air Force comments on the subject report. Specifically, you requested the Air Force Program Executive Officer for Fighter and Bomber Programs (AFPEO/FB) and the Director (sic), Air Force Operational Test and Evaluation Center (AFOTEC) to comment on this report. AFOTEC will provide separate comments. The comments in this document have been coordinated with the JHMCS Joint Program Office (JPO), Air Combat Command, HQ USAF, DOT&E, PEO(T), and NAVAIR staffs.

Air Force, Navy, and Contractor JHMCS personnel spent more than 400 man-hours discussing JHMCS program details and providing JHMCS program documentation to the DoD IG Team. The subject report contradicts information provided to the IG both verbally and via program documentation concerning several of the report findings and recommendations. Specific examples of such contradictions are included in the attachment.

Citing potential for release of proprietary information, the IG denied the JHMCS System Program Director initial recommendation to seek comment by JHMCS contractors. However, the JHMCS program office has reviewed the report and affirms that the report can be provided to Boeing, the JHMCS prime contractor, based upon current security and policy review procedures. Information from the prime contractor can be very helpful to guarantee the IG report ultimately reflects an accurate representation of the JHMCS program.

My point of contact for this project is Maj Aaron Clark, 703-588-7314 or
aaron.clark@pentagon.af.mil.

MICHAEL C. MUSHALA, Maj Gen, USAF
Air Force Program Executive Officer
for Fighter and Bomber Programs

Atch: Detailed comments to Audit Report on the Acquisition of the Joint Helmet
Mounted Cueing System (Project No. D2000AB-0220), dated December 8, 2000

**Detailed Comments to Audit Report on the Acquisition of the Joint
Helmet Mounted Cueing System (Project No. D2000AB-0220).**

Dated December 8, 2000

DoD IG Finding A, Utility of Planned Operation Testing:

1. "The JHMCS operational tests will not provide objective test results necessary to support the JHMCS full-rate production decision in April 2002 because of the following:
 - The Operational Requirements Document (ORD) did not identify operational parameters and articulate requirements in measurable terms."

Response: Non-Concur

Discussion: As a cueing and display system, the ORD requires JHMCS to cue the radar, navigation system, current and next generation short-range missiles, and to display on the visor information from these systems in a usable format similar to the aircraft head-up display (HUD). Further, the ORD requires JHMCS to cue these systems from -1G to 7.2G, to provide a means to cue beyond the physical limitations of the neck (uplooks), and to display the current line-of-sight (LOS) of each system. Objective technical requirements for display symbology, brightness levels, uplook limits, and cueing accuracy are contained in other technical and engineering documents. If JHMCS satisfies the above key performance parameters with both current and future weapons (e.g., AIM-9X), it follows that JHMCS will enable pilots to employ weapons more quickly and achieve the first-shot advantage described in the ORD. As stated in the ORD and other program documents, HMCS is a cueing and information display device that will benefit the warfighter by allowing aircrew to fully exploit off-boresight capabilities of fighter radars and missiles and to display vital weapons and target information for target verification and situational awareness. Finally, the ORD identifies as specific threat examples the Russian's MiG-29 and Su-27 fighters equipped with a helmet-mounted sight and advanced AA-11 missile. The capabilities of these aircraft were used to establish objective evaluation criteria in the classified TEMP annex that will be used during test. Failure of the system to cue weapons/sensors and display HUD information will be documented during test and will be reflected in objective, measurable Readiness and Logistics ratings for operational suitability and effectiveness.

DOD IG Finding A, Utility of Planned Operation Testing:

2. "The JHMCS operational tests will not provide objective test results necessary to support the JHMCS full-rate production decision in April 2002 because of the following:
 - The Test and Evaluation Master Plan (TEMP) is outdated and insufficient to provide the overall structure for an objective testing program and to ensure that the operational tests will provide objective results that can determine whether the

program is operationally effective and suitable for meeting the warfighters' needs in entering production."

Response: Concur

Discussion: The TEMP as currently written is outdated and is being updated. In Dec 00, the JHMCS Joint Program Office released a draft update that is under review by the JHMCS Integrated Product Team (IPT).

DoD IG Finding A, Utility of Planned Operation Testing:

3. "The JHMCS operational tests will not provide objective test results necessary to support the JHMCS full-rate production decision in April 2002 because of the following:

- The Multi-Service Operational Test and Evaluation Plan did not include a baseline threshold or objectives to measure success, did not include plans for a valid statistical projection, did not specify pass-and-fail criteria, and did not include a confidence level for questionnaires developed to measure and project human factor elements of critical operational issues."

Response: Non-Concur

Discussion: The Multi-Service Operational Test and Evaluation Plan is consistent with the original TEMP and contains numerous test procedures to satisfy Critical Operational Issues (COIs) and meet identified Measures of Performance (MOPs). The updated Multi-Service Operational Test and Evaluation Plan will be consistent with the updated TEMP, and will include test procedures to evaluate JHMCS capabilities against the example MiG-29 and Su-27 threat aircraft with AA-11 missile and helmet-mounted sight. Results will be factored into the operational effectiveness assessment.

Responses to the human factors questionnaires will depend on the judgment of the testers to make professional assessments on human factor implications associated with JHMCS operation and employment. Regardless of statistical analysis techniques and sampling methods, these questionnaires will give the using commands insight into system characteristics that can be used to develop training, to refine operational concepts of operation and maintenance, and to suggest follow-on improvements.

DoD IG Recommendation (A.1.):

"We recommend that the Air Force Program Executive Officer for Fighters and Bombers (sic) update the Test and Evaluation Master Plan to recognize changes as a result of the program restructure, identify the threat threshold and enhancement values of the system, and establish a process to update on a regular basis the Test and Evaluation Master Plan."

Response: Concur

- The TEMP will be updated. In Dec 00, the JHMCS Joint Program Office released a draft update that is under review by the JHMCS IPT.
- Although DoD 5000.2-R (Interim) is open to interpretation as to whether a threat baseline must be specified in the TEMP, particularly for ACAT III programs, a description of the threat HOBS capability will be added to the classified appendix for the TEMP update.
- The TEMP will be updated in accordance with processes specified in AFI 99-102.

DoD IG Recommendation (A.2.):

"We recommend that the Director (sic), Air Force Operational Test and Evaluation Force (sic), revise the Multi-Service Operational Test and Evaluation Plan to include changes made to the Test and Evaluation Master Plan that affect the Plan, identify pass and fail criteria for the questionnaires used to evaluate human factors, and revise the statistical projection plan."

Response: Non-concur

- The OT Plan will be revised to reflect the TEMP currently under revision. However, we do not concur with the recommendation to identify pass/fail criteria for the human factors questionnaires. The questionnaires are intended to gather subjective inputs and will help the user better understand the operational impacts of supporting and employing this new capability. As stated in the Test Plan, questionnaire results will be supplemented with additional information, such as test team observations, interviews, mission debriefs, and deficiency reports. It will be this volume of data that will allow the testers to render their professional opinion on operational effectiveness and suitability.
- Further comment is deferred to AFOTEC.

DOD IG Finding B, Adequacy of Acquisition Planning

"The JHMCS acquisition approach is not effective because the acquisition plan is outdated, does not address low rate initial production, does not recognize the risks associated with the restructure and the contracting structure of the JHMCS program, and does not explore component breakout opportunities for full-rate production. As a result the joint program office will miss the opportunity to put funds of approximately \$17 million to better use."

Response: Non-Concur

Discussion: Non-concur with IG that JHMCS Acquisition Planning is outdated. JHMCS Acquisition Planning is current and documented. DoD 5000.2-R requires an Acquisition Strategy be developed and updated: "The PM shall initially develop the acquisition strategy at program initiation and shall keep the strategy current by updating it whenever there is a change to an approved strategy..." AFFARS 5307.103.9 requires System Acquisition Management Plans (SAMP) only for ACAT I and II programs. JHMCS is an ACAT III program and as such is not required to have a formal SAMP. However, due to development complexity and as an

acquisition initiative a JHMCS SAMP was developed and coordinated by each service at Milestone II (start of engineering and manufacturing development). While the actual JHMCS SAMP document has not been updated since initial approval in Nov 96, the acquisition planning and strategy have been updated several times. These include:

- LRIP1 Acquisition Strategy Panel (ASP) Briefing and Minutes—March 99
- HOBS General Officer Steering Group Briefing and Minutes—December 99
- JHMCS Acquisition Program Baseline (APB) update—March 00
- LRIP1 Acquisition Review Board (ARB) Briefing, Minutes and Direction—May 00
- LRIP2 Acquisition Strategy Panel Briefing and Minutes—Aug 00

All of these activities were reviewed and concurred with, in writing, by the Milestone Decision Authority, the Air Force Program Executive Officer for Fighter and Bomber Programs with representation by the Navy Program Executive Officer (Tactical). These activities occurred in the context of an acquisition planning update and were so noted in the minutes. The JHMCS acquisition planning strategy is not outdated. The acquisition strategy is current and documented. The SAMP, TEMP and Joint Service MOA will be updated prior to Milestone 3 (full rate production) to fully consolidate program changes and documentation since the last milestone review.

Non-concur with IG that JHMCS risk assessment processes are inadequate. JHMCS risk assessment processes are well established. The JHMCS program follows Aeronautical System Center (ASC) policies and procedures for conducting Acquisition Strategy Panel assessments prior to new contract awards. The ASC process involves aggressive risk analysis and evaluation of alternatives in all functional areas. This aggressive risk assessment was completed for both LRIP1 and LRIP2. The Navy also required extensive risk analysis as part of their LRIP1 ARB process and was so documented.

The JHMCS program and contractor have an extensive, monthly, on-going risk assessment process for all technical program issues. It is this risk program that identified significant HOBS integration issues with the AIM-9X on the F-15C/D aircraft. The JHMCS risk process also identified potential operability and supportability issues in advance of the F/A-18 operational assessment completion. The December 1999 JHMCS program restructure was accomplished in order to reduce overall program technical risk. The insertion of LRIP1 and LRIP2 was accomplished after careful consideration of diverse aircraft platform integration, retrofit and forward fit installation requirements, and risks. For example, the LRIP2 date was specifically established to allow combined DT/OT testing of redesigned components prior to a production decision. The JHMCS restructure manages technical, programmatic and integration risk across four aircraft types in a prudent and cost effective manner.

Non-concur with IG that JHMCS Acquisition Planning does not address the potential cost savings of component breakout for full rate production. JHMCS considered component breakout as part of both the LRIP1 and LRIP2 ASP process. Component breakout was viewed as not acceptable due to on-going development risks, the immaturity of the principal subcontractor and the inability of the team to quantify cost benefits. At the LRIP2 ASP the JHMCS Program Director recommended, and the PEO concurred, that a breakout analysis be completed prior to Milestone 3. This analysis will be initiated in the spring of 2001.

Non-concur with IG estimated savings of \$17 million. The IG analysis is flawed. Referenced analysis assumes that all principal participants in the program—Boeing, VSI, Elbit

Fort Worth, Elbit Haifa, and Kaiser Electronics, add profit. The auditor analysis then eliminates the Boeing profit (\$5 million) and the VSI profit (\$11.8 million). This analysis provides the contractor team with zero profit since the VSI business arrangement with Kaiser, Elbit Fort Worth and Elbit Haifa allows for only VSI charging profit. Zero profit is in conflict with DoD acquisition regulations which direct reasonable profit be paid to contractors. Reinstatement of the VSI profit reduces the IG estimated savings to \$5 million from \$17 million. While \$5 Million in potential savings is significant, it is still less than 1% of the planned production buy. These savings will require validation relative to increased cost and risks associated with government vendor management, GFE risk, and integration risk.

DoD IG Recommendation (B):

"We recommend that the Air Force Program Executive Officer for Fighters and Bombers (sic) require the Joint Helmet Mounted Cueing System program manager to:

1. Conduct and present a component breakout study as exit criteria for the Engineering, Manufacturing, and Development phase (sic) that includes an analysis of potential net cost savings that can be achieved; and a review of the quality, reliability, performance, and the timely delivery of the end item that may be jeopardized."

Response: Concur

- AFPEO/FB provided this direction to the HMCS SPD at the LRIP2 ASP in Aug 2000.

DoD IG Recommendation (B):

"We recommend that the Air Force Program Executive Officer for Fighters and Bombers (sic) require the Joint Helmet Mounted Cueing System program manager to:

2. Revise the acquisition plan to include the results of the breakout study, the risks associated with low-rate initial production while in development, the restructure of the program, and the contracting structure of acquisition."

Response: Concur

- The Single Acquisition Management Plan will be updated to support Milestone 3.

DoD IG Recommendation (B.3.):

"We recommend that the Air Force Program Executive Officer for Fighters and Bombers (sic) require the Joint Helmet Mounted Cueing System program manager to:

3. Establish a process to update the acquisition plan on a regular basis."

Response: Non-Concur

Final Report Reference

Revised

Revised

No special process is required. Acquisition planning documentation will continue to be updated consistent with DoD 5000 and the ASC ASP process.

DoD IG Report Appendix A, Audit Process, Management Control Program Review, Adequacy of Management Controls

Non-concur with the IG's assertions that the JHMCS JPO controls for updating the acquisition and test plans are inadequate. Acquisition planning strategy and risk assessment is clearly documented in JHMCS documents other than the SAMP. Test plans are living documents and have been under constant review and change throughout the life of this program. A TEMP revision to update the TEMP to agree with current acquisition strategy is now under review by the JHMCS IPT. \$17M savings due to component breakout is not achievable given the IG report assumptions. The IG analysis is flawed (reduces contractor profit to zero) and does not consider additional costs to the Government to manage additional contracts, additional GFE, and be responsible for system integration.

Additional Comments and Corrections

The following comments are provided concerning the "Executive Summary" and "Background."

It appears the DoD IG Team does not have a clear understanding of the JHMCS. The IG began their introduction by stating:

"The Joint Helmet Mounted Cueing System consists of a helmet mounted display unit and aircraft interface components that will allow aircraft fighter pilots to engage and destroy airborne targets within visual range with a first look, first shot, first kill advantage provided by the High-Off-Boresight Capability. The capability allows the pilots to engage, lock, and launch weapons at a target beyond the range of the aircraft's radar and beyond the pilot's field of view. The capability works with the Navy's AIM-9X missile."

- While references to "first kill" appeared in early program documents (e.g., Joint Mission Need Statement, 14 Feb 1995), this capability can not be provided by JHMCS alone and has been deleted from the current ORD, TEMP, and Test Plans. JHMCS is primarily a cueing and display system that significantly contributes to first-shot HOBS capability only when integrated with the pilot, aircraft, sensors, and an appropriate HOBS weapon, such as AIM-9X.
- It appears the IG does not understand the employment of the AIM-9X or the limitations of JHMCS in the WVR arena. The report states: "The (HOBS) capability allows the pilots to engage, lock, and launch weapons at a target beyond the range of the aircraft's radar and beyond the pilot's field of view." This statement is not accurate. Although JHMCS can cue a HOBS weapon beyond radar field-of-regard (gimbal limits of the radar), radar range is basically a function of distance, which is unrelated to HOBS cueing. Also, for a pilot to visually cue radar or weapons to a target, the target must be within, not beyond, their field of regard. The JHMCS is capable of providing cueing information anywhere the pilot looks. The only limitation is the capability of specific sensors to follow the pilot cue. Many sensors have gimbal locks that preclude completely following the pilot cue. As

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sensors improve and are upgraded, the JHMCS will be able to support this upgraded capability.

- The IG report states that the HOBS capability “works with the Navy’s AIM-9X missile.” This statement should be changed. Unlike some earlier service-specific versions of the Sidewinder missile, the AIM-9X is a joint USAF/USN weapon with the Navy as lead service for development. JHMCS use is not limited to the AIM-9X. JHMCS can be used with a variety of inventory weapons and any other weapon or sensor, including air-to-ground, the warfighter chooses to integrate with JHMCS.
- The IG report claims “the absence of minimum threat and objective values in the ORD and the TEMP” as one of the reasons the testers plan to use friendly aircraft data as a comparative measure of operational effectiveness and suitability. This statement is both inaccurate and misleading. The report does not recognize AFOTEC’s attempts to schedule realistic threat adversaries, nor does it recognize previous missions that were flown against such adversaries. As a potential test limitation, the test plan and the TEMP clearly state that the use of surrogate and/or actual threat aircraft is a function of availability.
- The \$641 million identified as estimated total program cost is incorrect. \$641M is the cost for developing and producing 1,776 helmets and associated aircraft modification kits.

Revised



DEPARTMENT OF THE AIR FORCE
AIR FORCE OPERATIONAL TEST AND EVALUATION CENTER (AFOTEC)
KIRTLAND AIR FORCE BASE, NM 87117-5558

12 Feb 2001

MEMORANDUM FOR: ASSISTANT INSPECTOR GENERAL FOR AUDITING
OFFICE OF THE INSPECTOR GENERAL
DEPARTMENT OF DEFENSE

FROM: AFOTEC/CV
8500 GIBSON BLVD SE
KIRTLAND AFB, NM 871174558

SUBJECT: DOD IG Draft Joint Helmet Mounted Cueing System (JHMCS) Audit Report, Dated December 8, 2000

1. The following information is provided in response to the subject DOD IG draft audit report. The IG team stated in the report that "The Joint Helmet Mounted Cueing System operational tests will not provide the objective test results necessary to support the full-rate production decision in April 2002."

2. The draft report listed the following issues/concerns with the Multi-Service Operational Test and Evaluation (MOT&E) Plan, dated October 1999. "The Multi-Service Operational Test and Evaluation Plan did not include a baseline threshold or objectives to measure success, did not include plans for a valid statistical projection, did not specify pass-and-fail criteria, and did not include a confidence level for questionnaires developed to measure and project human factor elements of critical operational issues."

Response: Non-Concur

Discussion: The baseline effectiveness measures are to be evaluated by flying comparison missions of F-15/FA-18 aircraft with JHMCS vs. F-15/FA-18 without JHMCS. The test plan listed availability of actual threat aircraft with a helmet cueing system as a limitation to the test. It also states that flights will be conducted against the actual threat aircraft if available. The IG stated that as a minimum baseline comparison should be accomplished vs. the threat aircraft. The test team will conduct a baseline comparison of threshold aircraft with a JHMCS system and AIM-9X versus known threat aircraft capabilities as outlined in the Detailed Test Procedures and Data Management and Analysis Plan. The updated Test and Evaluation Master Plan (TEMP) will include threat capabilities to be used for the baseline comparison.

The inclusion of pass/fail criteria and confidence levels for the subjective human factors data would not be statistically valid given the small sample of 12 Air Force and Navy test pilots that will be utilized during MOT&E. A valid statistical projection plan would require using a sample size of helmets and pilots that would far exceed the combined resources of both the Air Force and Navy operational test agencies. However, the current sample of pilots is sufficient to provide clear answers concerning the impact of human factors elements on JHMCS operational effectiveness and suitability. A more detailed explanation of the AFOTEC position on these issues may be found in Attachment 1.

3. One of the report recommendations was: "We recommend that the Director (sic), Air Force Operational Test and Evaluation Force (sic), revise the Multi-Service Operational

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Test and Evaluation Plan to include changes made to the Test and Evaluation Master Plan that affect the Plan, identify pass and fail criteria for the questionnaires used to evaluate human factors, and revise the statistical projection plan."

Response: Non-concur

We will address any TEMP updates that affect the MOT&E. We do not concur with the recommendation to identify pass/fail criteria for the human factors questionnaires. The questionnaires are intended to gather subjective inputs and will help the user better understand the operational impacts of supporting and employing this new capability. As stated in the Test Plan, questionnaire results will be supplemented with additional information, such as test team observations, interviews, mission debriefs, and deficiency reports. It will be this volume of data that will allow us to render a professional opinion on the JHMCS operational effectiveness and suitability.

4. The JHMCS MOT&E will provide the necessary data to support a JHMCS full-rate production decision in April 2002.

Charles W. Griffin
CHARLES W. GRIFFIN
Colonel, USAF
Vice Commander

Attachment:
Memorandum for Record

30 January 2001

MEMORANDUM FOR THE RECORD

SUBJECT: Draft DOD IG Audit Report on the Acquisition of the Joint Helmet Mounted Cueing System (JHMCS): Human Factors Methodology Issues

1. The draft DOD IG audit report on the Acquisition of the JHMCS raised two issues that pertain directly to the evaluation of JHMCS human factors. First, the IG report stated that the small, non-random, sample of six Air Force and six Navy pilots is inadequate to achieve statistical confidence and "accurately project the operational effectiveness of human factors to the universe of Air Force and Navy pilots". Second, the IG has stated that the lack of quantifiable pass/fail criteria for the subjective, questionnaire based, assessment of human factors will not provide a clear answer regarding the effectiveness and suitability of JHMCS human factors. These two issues are closely interrelated and must be addressed jointly.

2. The DOD-IG indicated that, "since each test pilot's interaction with the JHMCS is independent, statistical sampling methods must be used to accurately represent the helmet's operational effectiveness." Although this is a reasonable assumption, the costs associated with achieving statistical confidence must be considered. For example, given a population of 1000 helmets, achieving a sampling error of plus or minus five percent with a confidence interval of 80% requires a sample size of 143. Increasing the sampling error to plus or minus 10 percent reduces the required sample to 40. The substantial costs associated with procuring additional test helmets as well as the tremendous increase in the number of required test flights to achieve even a modest degree of statistical confidence would be prohibitive given the current test budget.

3. The IG audit also questioned the non-random selection of pilots participating in the operational test. From a statistical viewpoint, random sampling is necessary in order to generalize the results from a sample to a subject population; however, random sampling is not reasonable or practicable in the operational test environment. It would impose a tremendous burden on active military units to provide randomly selected pilots to participate in operational tests for an extended period of time. Additionally, it should be noted that the pilots selected to evaluate JHMCS are drawn from a pool of experts with extensive experience in determining the military utility of the systems under test. Prior operational testing experience (as well as the literature from commercial software testing) has shown that a small group of experts is capable of identifying the vast majority of substantive system errors. Although it is clear that random sampling and increasing the sample size would increase statistical confidence in the results, it seems that the costs inherent in obtaining a statistically valid sample would far outweigh the benefits.

4. The absence of pass/fail criteria for the human factors data is driven to a large extent by the small sample size that is typically available for evaluating operational systems. As noted previously, JHMCS would require a minimum sample of 40 pilots in order to assign an objective pass/fail criteria with any degree of statistical confidence and it would be statistically invalid to apply criteria to data based on a small sample. Furthermore, even if an adequate sample were available, there are several other issues that should be considered before pass/fail criteria could be assigned. Human factors evaluations are inherently subjective because objective criteria are not available for most of the issues under consideration (e.g., helmet comfort or pilot situational awareness).

The subjective, questionnaire based data used to answer these questions are typically non-parametric which limits the applicability of standard statistical procedures. In addition, there is no scientific or operationally justified basis for accepting a particular subjective rating as a criterion for a system meeting an operational requirement. It is a matter of judgment, which should be made, based upon both the questionnaire ratings and additional sources of data received from the test subjects, including written and oral comments.

5. In consideration of the above issues, it was not considered appropriate to apply objective pass/fail criteria to the human factors analyses of JHMCS (or most other operational test programs). However, a definitive answer concerning the effectiveness and suitability of JHMCS human factors will be provided. For each subjective and/or comments are positive or unfavorable if the majority of the ratings and/or comments are positive or unfavorable if the majority of the ratings and/or comments are unfavorable. Additional interviews will be conducted in instances where the ratings and/or comments do not provide a clear answer. In addition, descriptive statistics will be used to summarize the data and a narrative summary of the major strengths and weaknesses of the system will be provided.

//Signed//
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Human Factors Analyst

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